NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

THE EFFECTS OF THE UTILIZATION OF GRADUATE EDUCATION ON PROMOTION AND EXECUTIVE OFFICER/COMMAND SCREENING IN THE SURFACE COMMUNITY: 1986-1994

by

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March, 1996

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE March 1996	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE : THE EFFECTS OF THE UTILIZATION OF GRADUATE EDUCATION ON PROMOTION AND EXECUTIVE OFFICER/COMMAND SCREENING IN THE SURFACE COMMUNITY: 1986-1994

5. FUNDING NUMBERS

6. AUTHOR(S) KIM L. FUCHS

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)* This thesis examines the effect of graduate education on the career progression of Navy surface warfare officers. The probability of promotion to LCDR (O-4), CDR (O-5) and CAPT (O-6) grades as well as the probability of screening for XO and CO are used as career progression milestones. The analysis examines the effect on career outcomes of a graduate education background in general, differences in the effect of holding a Navy-funded graduate degree versus a non-funded degree, and whether the funded degree was in a technical or non-technical curricula. The thesis also investigates the effect of utilization of graduate education on career progression. Finally, the thesis examines the determinants of who decides to pursue (or is chosen to attend) a funded graduate program. The results support the conclusion that officers who select (or are selected for) the graduate education program have stronger undergraduate backgrounds and stronger job performance early in their careers. These traits raise a question of selection bias, since officers who have graduate education may have been more likely to promote even if they did not have graduate education. A test for selection bias was developed and incorporated in the career progression models. The results indicate that a fully funded graduate degre has a positive effect on the selected measures of career progression. The probability of promotion to O-6 was higher for officers who utilized their graduate degrees as an O-5 compared to those who utilized earlier in their careers. Finally, officers with non-technical graduate majors had a higher probability of promoting than those with technical majors.

14. SUBJECT TERMS	GRADUATE EDUCATION PROMOTION SURFACE WARFARE OFFICER		15. NUMBER OF PAGES 78 16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

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THE EFFECTS OF THE UTILIZATION OF GRADUATE EDUCATION ON PROMOTION AND EXECUTIVE OFFICER/COMMAND SCREENING IN THE SURFACE COMMUNITY: 1986-1994

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1996

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ABSTRACT

This thesis examines the effect of graduate education on the career progression of Navy surface warfare officers. The probability of promotion to LCDR (O-4), CDR (O-5) and CAPT (O-6) grades as well as the probability of screening for XO and CO are used as career progression milestones. The analysis examines the effect on career outcomes of a graduate education background in general, differences in the effect of holding a Navy-funded graduate degree versus a non-funded degree, and whether the funded degree was in a technical or non-technical curricula. The thesis also investigates the effect of utilization of graduate education on career progression. Finally, the thesis examines the determinants of who decides to pursue (or is chosen to attend) a funded graduate program. The results support the conclusion that officers who select (or are selected for) the graduate education program have stronger undergraduate backgrounds and stronger job performance early in their careers. These traits raise a question of selection bias, since officers who have graduate education may have been more likely to promote even if they did not have graduate education. A test for selection bias was developed and incorporated in the career progression models. The results indicate that a fully funded graduate degre has a positive effect on the selected measures of career progression. The probability of promotion to O-6 was higher for officers who utilized their graduate degrees as an O-5 compared to those who utilized earlier in their careers. Finally, officers with non-technical graduate majors had a higher probability of promoting than those with technical majors.

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I. INTRODUCTION

A. BACKGROUND

The effects of post secondary education on an individual's career has been studied extensively. The return on investment for pursuing graduate education has been investigated by several researchers. For example, David Wise conducted two studies in 1975 and concluded that graduate education provided a positive increase on salary.[1] Studies that have observed this effect have attributed the higher earnings to increased performance.

This study examines the effect of graduate education on the job performance of naval officers. In addition, the study examines the effects on the career of naval officers of a few graduate education related issues such as utilization of those with graduate degrees and the differences between those with a technical and non-technical majors. The important question investigated is the difference graduate education makes in the promotion to Lieutenant Commander (LCDR), Commander (CDR) and Captain (CAPT) in the Surface Warfare Officer (SWO) community. The SWO community was chosen for this study because, in addition to promotion, screening for Executive Officer (XO) and Commanding Officer (CO) may be used as measures of performance. In the other warfare communities (Submarine,

[1] Wise. David A., "Academic Achievement and Job Performance," American Economic Review, vol. 65, no. 3, pp. 350-366, 1975.
& "Personal Attributes, Job Performance, and Probability of Promotion." Econometrica, 43(5-6), September-November:913-931.

Pilot and Naval Flight Officer) the screening process for XO and CO in some cases does not exist and in others does not take place at the same grade or career points.

The unique aspect of the analysis in this thesis is the inclusion of screening for XO and CO as measures of performance in determining the effects of graduate education. Also, this study uses data on an officer's Fitness Report (Fitrep) performance as seen in a previous study by Buterbaugh, and data on stated officer preferences for graduate education.[2] This study also delves further into the graduate education issue in the Navy by examining the effect of utilization tours on an officer's career as well as the effect of technical versus non-technical graduate programs.

Many officers perceive that undertaking Navy-sponsored graduate education may be risky to their careers. The increased academic accomplishments may make them more competitive for promotion among their peers, but may also work against them by taking them out of there warfare community at two different times during their career. The first time is to receive the education itself , and the second to utilize the education in a 'payback' tour. This "opportunity cost" of graduate education may make them less promotable since they cannot compete head-to-head with their peers, which could be a stumbling block for their career. The Chief of Naval

[2] Buterbaugh, Thomas A., " A Multivariate Analysis of the Effects of Academic Performance and Graduate Education on the Promotion of Senior U.S. Navy Officers," Master's Thesis , Naval Postgraduate School, June 1995.

Operations, trying to rectify this situation, has given instruction to the promotion boards, as well as informed the rest of the Navy, that graduate education should be viewed as a positive factor for promotion.[3]

B. OBJECTIVES

The analysis undertaken in this thesis examines the effect of graduate education on an officer's chance of promotion to the LCDR (O-4), CDR (O-5) and CAPT (O-6) grades as well as the chance of an officer screening for XO or CO. The study focuses on the SWO community due to the regimented career progression every Surface officer follows. In addition, the thesis examines the effect of utilizing a graduate degree on an officer's chances of promotion and screening.

Due to the nature of the SWO career progression, the study examines promotion to LCDR and CDR as a joint outcome with the screening processes of XO and CO, respectively. In other words, the XO screen variable, XOSCRN, represents the joint outcome of promoting to LCDR and screening for XO. Similarly, the CO screening variable, COSCRN, represents the joint outcome of promoting to CDR and screening for CO. The promotion to CAPT will be examined as a conditional outcome.

C. ORGANIZATION OF THE STUDY

This study has five chapters. Chapter I has provided a brief introduction to the topic of graduate education and the effect it has on

[3] U.S. Department of the Navy, Chief of Naval Operations, "Graduate Education Policy," CNO Ltr Ser 00/4U500182 of 27 July, 1994.

performance. Chapter II reviews some previous studies and gives a background of the graduate education system in the Navy. Chapter III describes the data set used for this analysis as well as specifying the empirical models used for the study. Chapter IV presents the results of estimating the statistical models, and Chapter V summarizes the analysis and offers some recommendations.

II. LITERATURE REVIEW AND BACKGROUND

This section reviews the Navy's graduate education system, utilization policies and some past studies of the system. A discussion of the SWO career path is also included.

A. HISTORY OF GRADUATE EDUCATION

The Navy's graduate education system began in 1909 under the direction of the Secretary of the Navy (SECNAV), when the need for technically trained officers who specialized in Navy-specific fields of study was recognized. A special division was opened at the U. S. Naval Academy (USNA), in Annapolis, Maryland to administer advanced education to line officers. At the end of World War II Congress created a unique institution, the Naval Postgraduate School (NPS) to continue with the advanced education of the Navy's officers. In 1951 NPS moved to its current site in Monterey, California and graduate education at the USNA ceased.[4] Currently, NPS is not the only source of graduate education available to naval officers. Other types of graduate education available are via the Navy's Civilian Institution Program, scholarship programs and tuition assisted own-time graduate education.

The Civilian Institution Program allows the officer to attend one of 62 civilian institutions and study in 36 curricula that do not require direct navy

[4] Brutzman, Terri Ekelund, " An Analysis of the Navy's Graduate Education Program and Follow-On Utilization of Officers by Designator and Subspecialty," Master's Thesis, Naval Postgraduate School, December 1994.

focus.[5] An example of this would be a chemistry degree at Cornell, which is the same whether you are a naval officer or not; another example would be an operational oceanography degree at M. I. T. The officers that complete graduate education either at NPS or a civilian institution are considered to have a fully funded graduate degree(FFGE). NPS, however, is the primary source of fully funded graduate education in the Navy and has 11 departments, four academic groups, and 35 technical and non-technical curricula.[6] An officer that desires graduate education can choose not to pursue a fully funded graduate degree and obtain graduate education on his own time. These officers work during the day and go to school at night or on weekends to complete a degree. The degree they receive does not meet Navy requirements and for that reason does not entitle the holder to a Navy subspecialty designation, also called a p-code. The next section will discuss p-codes and the Navy's subspecialty system.

B. SUBSPECIALTY AND UTILIZATION

An officer who completes a fully-funded graduate education program, tuition assisted off duty education, or serves two tours in a specific occupational specialty receives a 5-digit subspecialty code. The subspecialty system "was developed as a means to define the graduate education requirements for the Navy".[7] The system tracks billets that require special

[5] Naval Postgraduate School, Naval Postgraduate School Catalog, Academic Year 1994, 1994.
[6] Chief of Naval Personnel Memo Ser 004/4U500182, Graduate Education Policy, 27 Jul 94.
[7] Bureau of Naval Personnel (PERS-213), Officer Subspecialty System Handbook, January 1993.

knowledge to perform, as well as officers who possess specific knowledge in that field. The Navy categorizes billets and officers by using a five-digit subspecialty code that contains the functional field of the subspecialty, the educational/skill field and the educational/skill level. The subspecialty code allows for matching of billets with officers and the tracking of those officers. Appendix A describes the subspecialty coding system.

Designating a billet as requiring a subspecialty code mandates a review by the Subspecialty Requirements Review (SRR) board. This meeting is held for each subspecialty and provides a quality check that qualified p-coded officers are utilized in billets that require p-code knowledge.[8] A biennial review of the curricula ensures that the skills of the officers being produced are aligned with the requirements of the specific p-coded billets. These biennial reviews are conducted by the Primary Consultants for the subspecialty and the curricular officers at NPS. These reviews provide the system with a check to maintain consistent education in the desired areas of study.

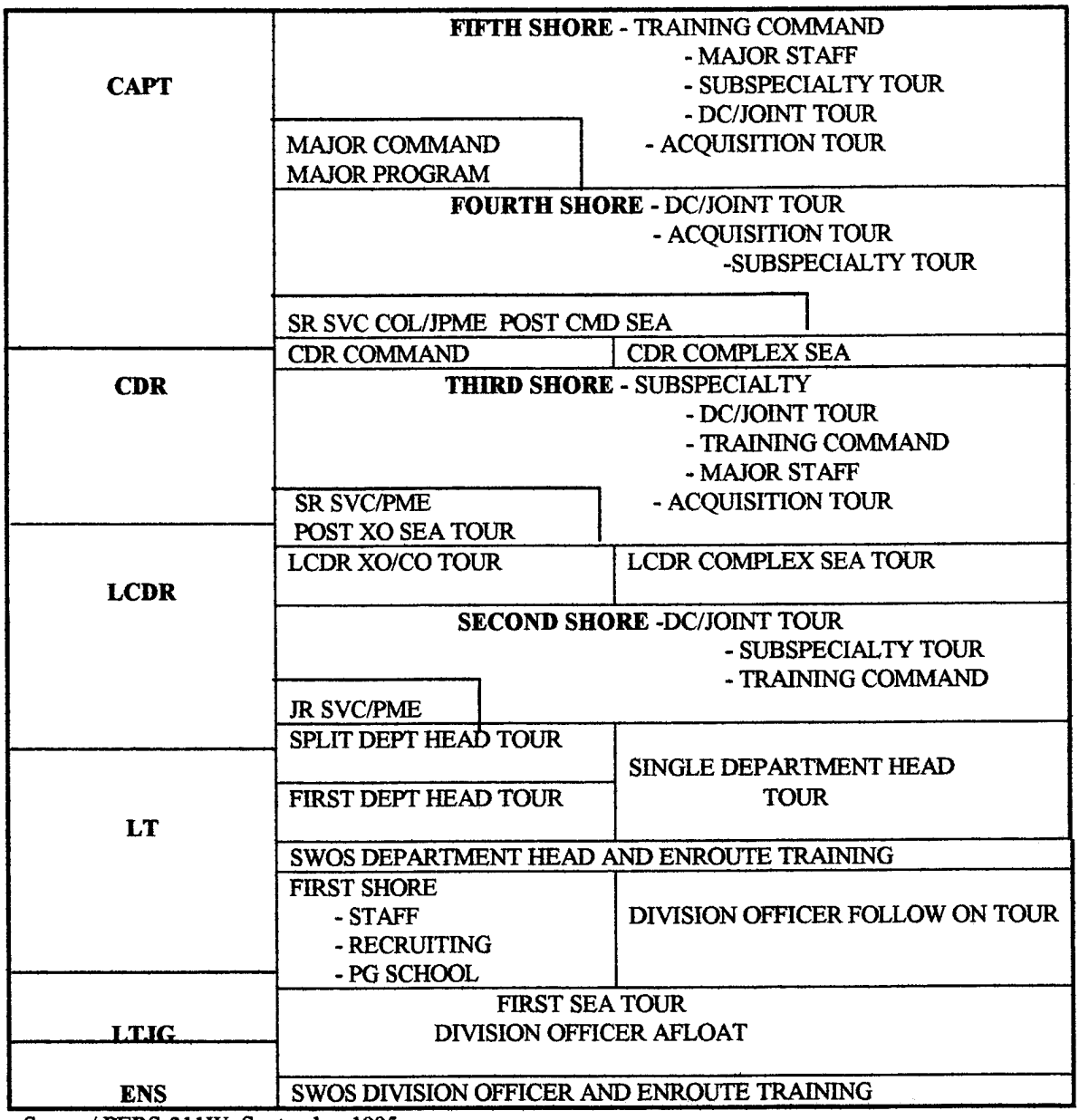
The number of p-coded billets drive the annual quota of officers to be sent to obtain graduate degrees. A quota model is used to establish the flow of new officers needed for each subspecialty and designator each year. Once the required number of p-coded officers are produced they must be tracked. The tracking of officer utilization is required by the Department of Defense

[8] Ibid.

(DoD). Utilization is required in a 'payback' tour within two tours by DoD directive 1322.10 " Policies on Graduate Education for Military Officers." The payback tour must be in a billet related to the subject area of the graduate education.

C. SURFACE WARFARE OFFICER CAREER PATH

Command at sea is the penultimate goal of every sailor. A newly commissioned Ensign who first checks on board has the lofty aspirations of one day sitting in the Captain's chair. During the course of a career there are many choices and obstacles the officer must overcome. Which ship type to request? What job to request? When to serve in a joint billet? Is graduate education necessary for a successful career? These are all questions an officer ponders. The officer is not alone in all these decisions, as the detailer is there to aid and guide the officer. The detailer also helps match the needs of the officer with the needs of the Navy, and to create the most qualified candidate for promotion and command. The surface career path as depicted in Figure 1 shows the many different choices an officer has before having a chance for command at sea.



Source/ PERS-211W, September 1995

Figure 1. Surface Warfare Officer Professional Development

The review of Lieutenants (O-3) for promotion to Lieutenant Commander (LCDR) usually occurs near the nine or ten year point in the Navy. After this decision the officer must be screened for Executive Officer

(XO). At this screening board there are three results: selection to be an XO; failure to select to be an XO; and an early screening for Command (CO). According to the Surface Warfare community manager these early screens are the "true" top 10% of the surface community. [9] These LCDR Commanding Officer Screened officers are the best and the brightest in the surface community.

After serving as an XO or LCDR CO the next significant review occurs at the fourteen or fifteen year point when the officer is eligible for promotion to Commander (CDR). Once an officer is promoted, the CO screen takes place and the officer is either selected for command or not. Figure 2 gives a simple view of the basic milestones in a surface officer's career after Lieutenant.

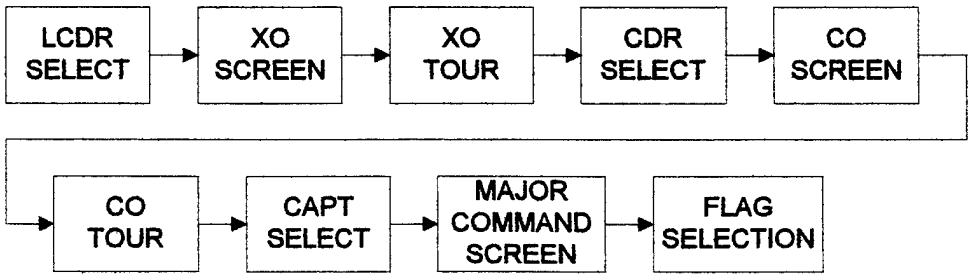


Figure 2. Simplified SWO Career Path

Research on the effects of graduate education for officers has been intensive in the recent past. The results indicate that completion of a graduate degree

[9] Conversation with CDR Pete Dougherty, Surface Warfare Officer Community Manager, 26 September 1995, Bureau of Naval Personnel, Washington D.C.

program is beneficial to an officer's career. What has not been studied is the effect on an officer who utilizes a graduate degree, rather than returning to an operational billet within the surface community.

D. PREVIOUS STUDIES

Several civilian studies have examined the relationship between graduate education and job performance. As mentioned in the first chapter, Wise conducted two studies in 1975. In one he found that when he modeled salary level, salary growth, and promotion, as the measures of performance, a higher grade point average and graduating from a more selective college were positively related to a higher salary growth. His linear probability study also revealed that graduate education increased salary if the individual was in the top third of his graduate school class and, he had a master's degrees in the technical fields rather than the non-technical business fields. Wise also found that the effects of academic and non-academic attributes were equal in explaining productivity. The second study he undertook focused on the probability of promotion as the measure of performance. He undertook this because people who do not promote may in fact receive pay increase as their time with the company increases. This second study found similar general outcomes, but much larger positive effects of having a high GPA and being from a selective college.

Another study of the civilian workforce of an individual firm was performed in 1986 by Jennie Woo.[10]. She used linear probability methods to determine the effects on annual earnings, salary growth, and evaluations and a non-linear LOGIT model to examine the effects on promotion. Her results were mixed and in some cases showed that graduate education had a negative effect on supervisor rating and promotion. Some of the discrepancies can be attributed to the sample she chose, which included all education levels (including high school dropouts) and excluded those individuals who left the corporation.

There have also been several military-specific studies of graduate education. The numerous studies performed by NPS thesis students indicate that academic performance as an undergraduate, as well as graduate education all have positive effects on performance when measured by promotion or fitness report performance.[11, 12] A recent analysis by Mehay and Bowman, " Graduate Education and Job Success in a Hierarchical Organization: Evidence from Military Personnel" also finds that the difference in performance within-grades is consistent with the civilian studies finding that earnings increase with increased education.[13]

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[10] Woo, Jennie H., "Graduate Degrees and Job Success: Managers in One U.S. Corporation," Economics of Education Review, vol. 5, no. 3, pp. 227-237, 1986.
[11] Jordan, Susan S., "An Analysis of the Impact of Graduate Education on the Performance and Retention of General Unrestricted Line Officers," Master's Thesis, Naval Postgraduate School, December 1991.
[12] Talaga, Michael T., " A Multivariate Analysis of the Effects of Graduate Education on Promotion and Retention of Surface Warfare Officers," Master's Thesis, Naval Postgraduate School, March 1994.
[13] Mehay, Stephen L. and Bowman, William R., " Graduate Education and Job Success in a Hierarchical Organization: Evidence from Military Personnel," Stanford University, November, 1995.

The Mehay-Bowman study examines the effect of graduate education on job performance using promotion to LCDR as the primary measure of performance. They view this as the first significant control point in an officer's career. They investigated the promotion history in the pre-drawdown years of the late 1980s for the Navy's Unrestricted Line communities. Their promotion models accounted for the basic demographic factors, the cognitive abilities of the student, accession source, and the percentage of early fitness reports that received a "recommended for early promotion." A unique aspect of this study divided the type of graduate education into a general graduate education category and then sub-divided that category into a fully funded and non-fully funded graduate education.

The analysis conducted in this thesis can be compared in some ways to the study by Mehay and Bowman to ensure congruent findings for Navy officers. The sample group and promotion grades compared are different because Mehay and Bowman looked at all URL and SWO LCDR promotions whereas this study examines SWO XO screening, CO screening and CAPT promotion. However, the general methodology of the two studies is similar, so that the trends can be compared. In general, the findings continue to indicate that graduate education has a positive effect on promotion and screening throughout a Navy officer's career.

III. DATA AND METHODOLOGY

This chapter describes the unique data base used. It also describes the methodologies used for the empirical analysis in the thesis.

A. DATA SET DESCRIPTION

The data used for this analysis was a compilation of files extracted from the Navy's Officer Promotion History Files provided by the Bureau of Naval Personnel (BUPERS) and Fitness Report Files provided by the Naval Personnel Research and Development Center (NPRDC) The data set was constructed by Professors William Bowman and Stephen Mehay specifically for use in the analysis of officer career progression. The data set was restricted for this thesis to include O-4, O-5, and O-6 promotion boards between 1986 and 1994. Also the data file was restricted for this analysis to Surface Warfare Officers (SWO), due to their large sample size and the homogeneity of career progression patterns in this community. The data set was divided into subsets including the officers lower rank and subsequent promotion opportunity. The Lieutenant Commander to Commander (LCDR-CDR) set contains 2,925 observations and the Commander to Captain (CDR-CAPT) set contains 1,471 observations. The number of officers eligible for screening and promotion for the upper two data sets can be seen in Figure 3 and Figure 4. The LT to LCDR data set was used to provide some important background for this thesis and contained 8,269 surface officers.

It is important to note that the data sets being used, even though they are in the same sequential career progression, do not follow the same officer's through there careers. The LCDR-CDR data set contains officers that were commissioned approximately between 1971 and 1979, while the CDR-CAPT data set contains officers commissioned between 1966 and 1974. It is possible that the same officer is in both data sets, but this does not adversely affect the study, the focus of which is the joint promotion/screening outcome.

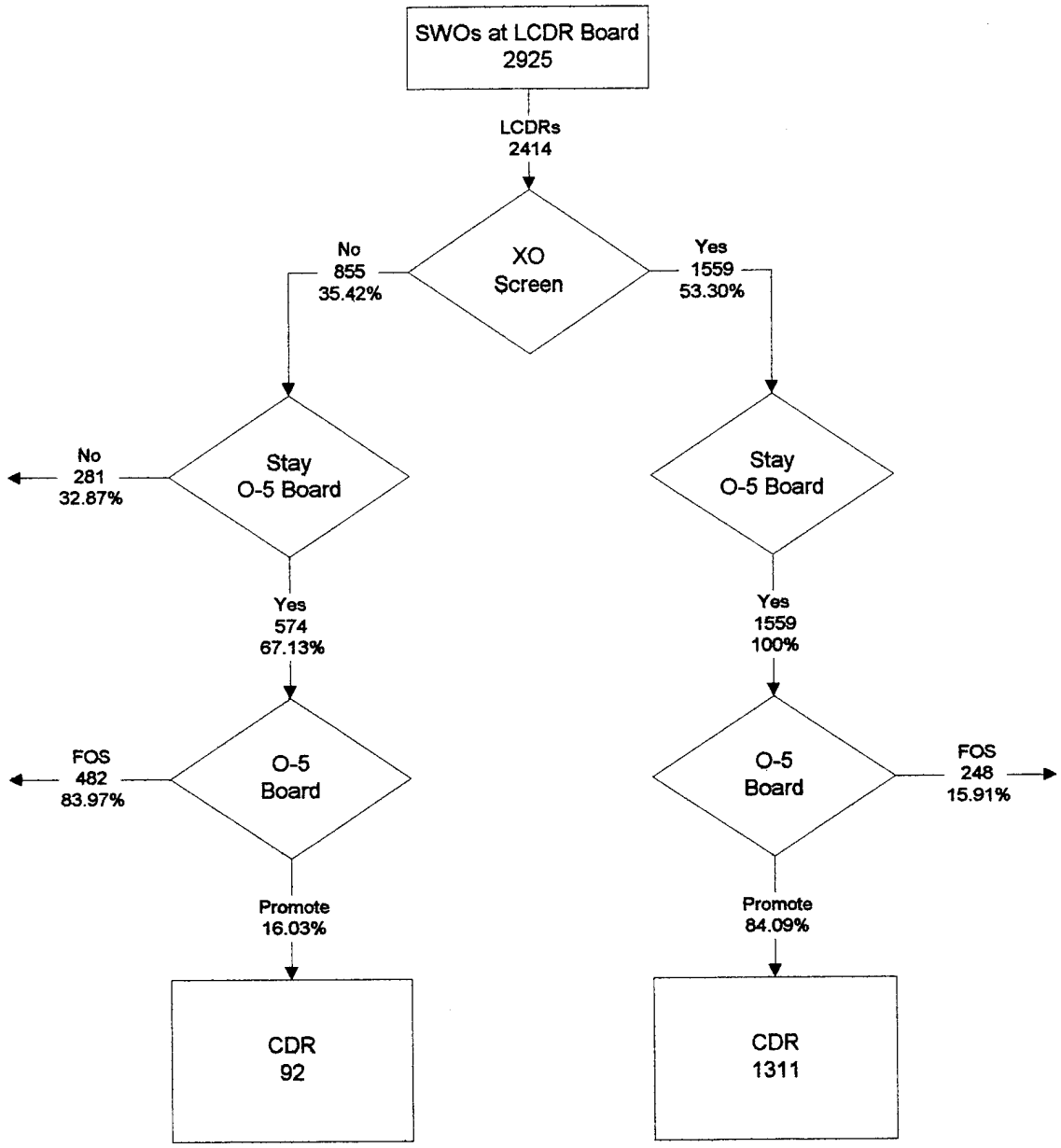

Figure 3. LCDR to CDR Data Set Flowchart: LCDR to CDR Promotion for Officers that Stay to LCDR Board

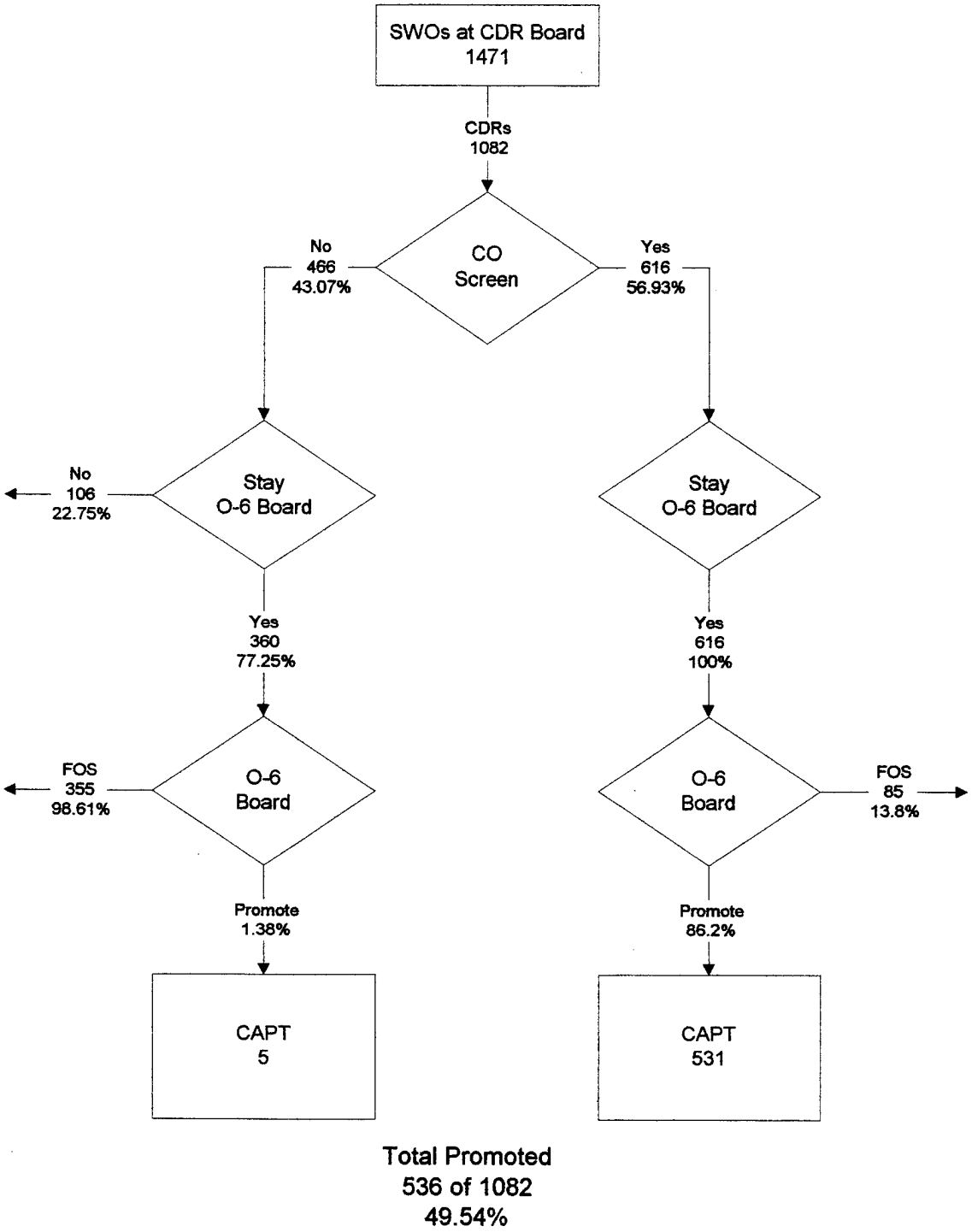

Figure 4. CDR-CAPT Data Set Flowchart: CDR to CAPT Promotion for Officers that Stay to CDR Board

B. METHODOLOGY

Creating well specified models to measure the effect of fully funded graduate education on the XO and CO screening process required some insight into the type of officers that tend to pursue graduate education. Initially, basic frequencies were obtained from the LT-LCDR data set then from all data sets, indicating that officers who completed graduate education remained in the Navy at a higher percentage. Once this pattern was established, a simple probit model was run to determine the important factors influencing the choice of graduate education in hopes of exploring some of the early background characteristics that might be correlated with the choice of graduate education, which, in turn, would lead to a more successful candidate for screening and promotion.

The main focus of this thesis, the effect of graduate education on CO screening and promotion to CAPT, led to the unique formulation of single stage non-linear probit models. A building block approach was used, following Mehay and Bowman, to observe the effect of additional controls on the model. The initial model contained the fully funded graduate education variable, some basic demographic factors, and the fiscal year dummies. The fiscal year dummies proved to be insignificant in the screening models and were therefore deleted. Each successive model thereafter contains an increasingly inclusive set of controls. The building block modeling, in general, is best described through simple mathematical formulations:

Model One Screening/Promotion Outcome = f(graduate education, X)

Model Two Screening/Promotion Outcome = f(graduate education, X, Y)

Model Three Screening/Promotion Outcome = f(graduate education, X, Y, Z)

X= vector of demographic factors,

Y= accession sources,

Z= measure of early military performance.

It is important to point out that the measure of performance outcome chosen to determine the effect of fully funded graduate education is CO and XO screening. These measures capture the joint outcome of being promoted from the previous rank and successfully screening for the appropriate duty. So, the CO screen variable is coded COSCRN=1 when an officer is promoted to CDR, and successfully screens for command. The officer can be promoted to CDR but if they do not screen for CO then the variable COSCRN equals zero. Since there is not enough information in the data set about major command screens the PROMOTE variable was used as the single outcome for promotion to CAPT.

The models used for the promotion to CAPT and also for XO screening are similar to the final CO screening model. Differences in the models arise due to the smaller sample size of the CDR-CAPT data set and the lack of variance in some of the variables. As an illustration there were only two

females eligible for promotion in the CDR to CAPT data set, so the gender variable was deleted from those models. Appendix B lists the explanatory variables for the different models used in this study.

The analysis proceeds in the following fashion. Examining the LT-LCDR data set gives a good overview of who seeks graduate education, and the probability of their staying in the Navy. Models of career progression as measures of performance are estimated in the two more senior data sets. These career progression measures are XO screening, CO screening and promotion to O-6. The XO screening, CO screening and CAPT promotion models are used to determine the effects of fully funded graduate education on career progression. Then other models using the same career progression measures are included to analyze the effects of utilization and the differences in the effects of technical versus non-technical majors. The next section discusses the specification of the variables used in this analysis.

C. CODING OF VARIABLES

Since the focus of this analysis is the effect of graduate education on an officer's career, namely the XO screening, CO screening and CAPT promotion board, the coding of graduate education was as specific as possible. It was not simply coded as those with graduate education and those without, but was sub-divided into funding source and technical content of one's major. Firstly, a variable was constructed to include all types of graduate education and was called GEDUC. This variable was useful in

determining what type of officer pursued graduate education. Graduate education was then specified further to include only fully funded graduate education (FFGE), which was the main focus of this analysis since fully funded graduate education is the investment the Navy makes to produce a qualified p-coded officer. Fully funded graduate education was then sub-divided into either fully funded technical (FFTCGRAD) , or fully funded non-technical (FFNTGRAD) graduate education. In the LCDR-CDR data set, 25.71 percent of the SWO's have fully funded graduate education; 15.3 percent of the SWO's have a fully funded technical degree, and 10.36 percent have a fully funded non-technical degree.

Variables were constructed for the normal demographic factors that are included in human capital based studies of productivity. Minority status was divided to include African Americans (AFAMER) and other minorities (OTHRACE). Gender was also included (FEMALE = 1). Marital status was included and then subdivided by the number of children in the family, since other studies have shown that married workers tend to earn more, indicating greater productivity. The variable MARONLY was used for officers that were married with no children, MARCHILD were married members with children, and DIVCHILD were divorced members with children.

Accounting for the officer's undergraduate education and background is considered important, so variables were built for the various accession sources. These sources were the Reserve Officer Training Corps (ROTC),

Officer Candidate School (OCS), United States Naval Academy (USNA) and NESEP for officers with prior enlisted service. The academic history of the officer was considered by the inclusion of the Academic Profile Code (APC) and undergraduate major. APC1 indicates the officers collegiate grade point average. Since the requirements for ROTC and the USNA require technical and mathematical courses, an undergraduate education specifically in the scientific or technical fields was coded as UGTECH.

The officer's performance in his early military career is judged by the number of fitness reports on which the officer is recommended for early promotion by his superiors. A binary variable, RAPPED, was constructed that summarized the officer's early fitness reports as an Ensign and Lieutenant Junior Grade and was given a value of one if the officer had ever received a 'Recommended for Early Promotion' report, and given a value of zero otherwise.

It was necessary to account for the differences in the opportunity for promotion throughout the many years covered by the data. Some boards were held prior to the drawdown that began in the late 1980s, and others were held during the drawdown. Fiscal year dummies were created to account for the different chances of promotion for each year of the study in which the promotion board met.

Some officers that have a preference for specific graduate education may do better than officers that do not have such preferences. This was

accounted for by dummy variables for one's preference for attending graduate school. These variables were taken from the officer's own preference cards and indicate a technical preference (TCPREF), non-technical preference (NTPREF), or a preference for either technical or non-technical (BOTHPREF) graduate education. These variables can be used in identifying the junior officer's taste for graduate education.

An additional part of this study is concerned with the utilization of graduate education by surface officers. Two dummy variables were devised , EVERUSE and HEVERUSE, to indicate if the officer had utilized their degree. In the CDR-CAPT data set the EVERUSE variable observes the officer at the lower promotion board(O-5) for the utilization trait, and the HEVERUSE variable looks for the same utilization trait, but at the higher board(O-6). As an example, in the LCDR-CDR data set, an officer that is coded EVERUSE=1 is an officer who used his graduate education p-code before the LCDR board. In the same data set an observation coded HEVERUSE=1 indicates an officer that utilized their p-code before they reached the CDR selection board, either as a Lieutenant or as a Lieutenant Commander. Of course, any observation with EVERUSE=1 will automatically have HEVERUSE=1. The HEVERUSE variable in the LCDR-CDR data set roughly equates to the EVERUSE variable in the CDR-CAPT data set, because they both indicate utilization by the officer as a LCDR or earlier.

Table 3.1 lists the simple frequencies for the variables labels by data set, while Table 3.2 shows the mean percentages of the explanatory variables for the total sample size in columns 1 and 3, and in columns 2 and 4 the mean percentage for those who screened to XO and CO.

Table 3.1 Frequencies for LCDR-CDR and CDR-CAPT Data Sets

	LCDR-CDR Data Set		**CDR-CAPT Data Set**	
	Total	Screened	Total	Screened
Sample Size- n	2,925	1,559	1471	616
FFGE	752	523	465	238
FFTCGRAD	449	281	243	118
FFNTGRAD	303	242	222	120
FEMALE	46	36	2	1
AFAMER	152	73	32	10
OTHRACE	43	20	7	2
MARONLY	710	414	196	80
MARCHILD	1508	792	1102	485
DIVCHILD	86	37	48	10
UGTECH	1489	745	520	202
ROTC	860	473	356	147
OCS	848	452	422	155
NESEP	366	109	133	32
RAPPED	1187	870	221	119
EVERUSE	8	3	33	13
HEVERUSE	235	141	238	140

Table 3.2 Percentages for LCDR-CDR and CDR-CAPT Data Sets

	LCDR-CDR Data Set		CDR-CAPT Data Set	
	Percent of Total (n=2,925)	Percent of those Screened (n=1,559)	Percent of Total (n=1,471)	Percent of those Screened (n=616)
Sample Size- n	100%	100%	100%	100%
FFGE	25.7%	33.5%	31.6%	38.6%
FFTCGRAD	15.3%	18.0%	16.5%	19.1%
FFNTGRAD	10.3%	15.5%	15%	19.4%
FEMALE	1.5%	2.3%	.14%	.16%
AFAMER	5.2%	4.6%	2.1%	1.6%
OTHRACE	1.4%	1.2%	.48%	.32%
MARONLY	24.2%	26.5%	13.3%	12.9%
MARCHILD	51.5%	50.8%	74.9%	78.7%
DIVCHILD	2.9%	2.3%	3.2%	1.6%
UGTECH	50.9%	47.7%	35.3%	32.7%
ROTC	29.4%	30.3%	24.2%	23.8%
OCS	28.9%	28.9%	28.6%	25.1%
NESEP	12.5%	6.9%	9.0%	5.1%
RAPPED	40.5%	55.8%	15%	19.3%
EVERUSE	.27%	.19%	2.2%	2.1%
HEVERUSE	8.0%	9.0%	16.1%	27.7%

After the description of the explanatory variables, we are now able to be more accurate in describing the specification of the estimating models. Following the format from the methodology section, the three models estimated were specified as indicated below. Model One includes only the basic demographics; Model Two adds the commissioning source dummies, and Model Three adds the fitness report performance variable. The next chapter contains a discussion of the results of the analysis and the models.

Model One: CO Screening/Promote to O-5= α_0+ β_1FFGE+ β_2AGE01+ β_3MARONLY+ β_4MARCHILD+ β_5DIVCHILD

Model Two: CO Screening/Promote to O-5= α_0+ β_1FFGE+ β_2AGE01+ β_3MARONLY+ β_4MARCHILD+ β_5DIVCHILD+ β_6ROTC+ β_7OCS+ β_8NESEP

Model Three: CO Screening/Promote to O-5= α_0+ β_1FFGE+ β_2AGE01+ β_3MARONLY+ β_4MARCHILD+ β_5DIVCHILD+ β_6ROTC+ β_7OCS+ β_8NESEP+ β_9RAPPED

IV. ANALYSIS RESULTS

A. ACQUISITION OF GRADUATE EDUCATION

1. Investing in Human Capital

This study is interested in the return on investment, to both the Navy and Naval officers, in fully funded graduate education programs. The cost the Navy incurs initially is quite large. A study performed by Bowman states that the cost of a non-technical degree at NPS exceeds $100,000.[14] This initial outlay on firm-specific knowledge by the Navy is expected to result in significant increases in productivity and/or longer job tenure, which reduces turnover of the Navy's officer corps. The reduced turnover saves the Navy the cost of replacing officers who leave, often at 8 to 10 years of service. Replacement costs can reach several million dollars per person for some officers such as pilots and highly trained nuclear officers.

Since measuring officer productivity is difficult, the Navy often measures returns to education in terms of the longer job tenure of its officers. The officers who complete graduate education are more likely to stay in the Navy long past their initial commitment. Table 4.1a shows the frequencies and percentages of officers by type of graduate education and Table 4.1b shows the frequencies and percentages of officers who stay to the LCDR board by type of graduate education. The LCDR board occurs at

[14]Bowman, William R., "Non-Technical Graduate Education Programs in the United States Navy: A Cost Effectiveness Study of the Naval Postgraduate School", Prepared for Department of the Navy, Bureau of Personnel, BUPERS-21/OP01, December 1992.

approximately the 10-year point in the officer's career. Therefore, the officers who stay to the LCDR board have committed to the Navy for at least 10 years. The percentages indicate that 99 percent of officers with fully funded graduate education stay to the 10-year point. The officers who acquired

Table 4.1a Frequencies and Percentages of Officers by Type of Graduate Education in the LT-LCDR Data Set

Graduate Education Type	Frequency of Officers with Grad Ed	Percent of Officers with Grad Ed Type (Grad Ed type/8,269)
All Grad Ed	1,218	14.73%
Part Time	209	2.53%
Fully Funded	1009	12.20%
Fully Funded:		
Technical	740	8.95%
Non-Technical	269	3.25%
No Grad Ed	7,051	85.27%
Total	8,269	100%

Table 4.1b Frequencies and Percentage of Officers Who Stay to LCDR Board by Graduate Education Type in the LT-LCDR Data Set

Graduate Education Status	Officers with Grad Ed Type that Stay to O-4 n=8,269	Percent of Officers with Grad Ed Type that Stay to O-4
All Grad Ed	1,172	96.22%
Part Time	170	81.34%
Fully- Funded	1002	99.31%
Fully Funded:		
Technical	735	99.32%
Non-Technical	267	99.26%
No Grad Ed	2,691	38.16%
Total	3,863	

graduate education on their own time leave the service at a greater rate, having only an 81 percent rate of retention to the 10-year point. On the whole, 96 percent of officers with any type of graduate education stay to the LCDR board, compared to retention rates of only 38 percent for those without graduate degrees.

2. Fully Funded Graduate Education Probit Models

Before analyzing the impacts of graduate education, it is worthwhile to analyze who acquires graduate education in fully funded programs. The background characteristics of individuals who pursue graduate education is carried out with the LT-LCDR data set. The initial steps are to determine those variables that are significant in predicting which officers choose to attend graduate education. Probit models of this decision are estimated and the results are shown in Table 4.2.

Table 4.2 Probit Parameter Estimates of Determinants of Attending Navy Fully Funded Graduate Programs (FFGE) and of Attending Any Graduate School (GEDUC)

Explanatory Variables	Probit Coefficients for FFGE Model (Standard Error)	Probit Coefficients for GEDUC Model (Standard Error)
INTERCEPT	-.9839*** (.2472)	-2.119*** (.2120)
Age at Commissioning	-.0512*** (.0110)	.0437*** (.0092)
Male	.2592** (.1423)	.3234** (.1336)
African American	-.0414 (.0947)	-.0564 (.0870)
Other Minority	-.0410 (.1121)	.0093 (.1039)
Married Only	.1515*** (.0437)	.1640*** (.0413)
Married with Children	.1543** (.0619)	.1392** (.0568)
Divorced with Children	.0472 (.1862)	.1667 (.1561)
APC1 (Grades)	-.1488*** (.0204)	-.1700*** (.0191)
Undergraduate Technical Major	.2880*** (.0427)	.1935*** (.0399)
ROTC	-.0962** (.0482)	-.1361*** (.0468)
OCS	-.3591*** (.0600)	-.4169*** (.0561)
NESEP	.2563*** (.1098)	-.0526 (.1024)
Technical Preference	.6035*** (.0576)	.5704*** (.0561)
Non-Technical Preference	.1193* (.0743)	.1726*** (.0657)
Technical and Non-Technical Preference	.3017*** (.0624)	.3192*** (.0588)
Received RAP as O-1 - O-2	.6750*** (.0396)	.6096*** (.0365)
Concordance Ratio	.753	.727
-2 Log L	660.8	727.1
Sample Size	8,269	8,269

Note:
* significant at .10 level
** significant at .05 level
*** significant at .01 level

The results indicate that there are many important factors that are associated with the individual decision to attend graduate school and the Navy's decision to accept an individual for the fully funded graduate education programs. First, concentrating solely on the fully funded model in column 1, it is apparent that officers who seek or are selected for Navy-sponsored graduate education have better undergraduate records, and are more likely to have a technical background. Compared to individuals with no preference for graduate education, those who indicated any preference, whether it was for technical, non-technical or both were more inclined to attend a funded graduate education program. Finally, married officers with and without children pursue graduate education at a higher rate.

When comparing the results for the entire graduate education model in column 2 there are slight differences with the fully funded model in column 1. Individuals with a non-technical preference have a larger positive effect on choosing any graduate school in general then in choosing fully funded education. The reason for this may be that officers who want to gain a graduate education on their own time would more likely choose a non-technical, non-Navy-specific degree, such as an MBA, or other business degrees, which would prepare them for a career outside of the naval service.

Officers with a solid early career are more likely to attend both types of graduate programs. The RAPPED variable is large, positive and highly significant for both types of graduate education. The type of officer who

undertakes graduate education, therefore, has a stronger undergraduate background, is more likely to be married, has indicated a preference for some type of graduate education, and has performed well in the eyes of his reporting senior as a junior officer.

The probit models of fully funded graduate education, and the frequencies of officers who stay to the 10-year point indicate that those who have a stronger taste for the military prefer the opportunity to obtain graduate education and the commitment which follows. These officers also tend to have stronger academic backgrounds and better junior officer performance records. The coefficient of the RAPPED variable is larger in the FFGE model, which supports the conclusion that the officers who pursue fully funded graduate education are even stronger performers as junior officers than those that pursue graduate education on their own time.

One of the least understood benefits of graduate education to the Navy is the fact that those who pursue graduate education incur an additional obligation to the Navy. Furthermore, an individual's interest in funded education is an early sign of his interest in a career in the Navy. Officers who desire graduate education are more likely to apply for and be accepted to the graduate program, and once they have completed graduate education are more prone to stay to the 10-year point and beyond. If these early signals can be determined, such as via the individual's preference card, the Navy can know by the 2- or 3-year mark, (when officers respond to the

graduate education preference survey) as to which officers have a predilection to make the Navy a career. Since most fully funded graduate education is obtained while the officer is at the 5- to 8-year point, it is beneficial for the Navy to determine this desire early in the officer's career.

3. Career Progression and Graduate Education

Table 4.3 shows that as officers progress through the Navy, the percent of the officer corps with graduate education increases. This increase can best be explained by two reasons. The first is that the longer someone stays in the military the longer they have to pursue their graduate education goals. Since most officers acquire graduate education between the 5- and 8-year of service point, a second, and more important, reason is that officers who obtain graduate education are more likely to stay in the military and more likely to be promoted. These findings suggest that the Navy is obtaining a return on its human capital investments in graduate education in two ways: (a) the increased tenure of graduate-educated officers and (b) the increased promotion rates.

Table 4.3 Frequencies of Fully Funded Graduate Education by Data Set

Data Set	Sample Size	Fully Funded Grad Ed	Percent with FFGE
LT-LCDR	8,269	1,009	12.20%
LCDR-CDR	2,925	752	25.71%
CDR-CAPT	1,471	465	31.61%

The higher percentage of officers with graduate education in the more senior data set may be indicative of the positive impact of graduate education on screening and promotion. Table 4.4 shows the differences in performance measures throughout an officer's career by types of graduate education. XO screening rates are compared for officers with fully funded graduate education (column 1), and officers in the not fully funded graduate education category- - which includes those with no graduate degree and those who received a degree part time. As noted in the table, officers with fully funded education screen at a 21.8 percent higher rate than those without fully funded education. In addition, officers with a fully funded technical graduate degree have 14.8 percent higher screening rate to XO, than those without fully funded graduate education. Similarly, those possessing a non-technical degree screen at a 32.1 percent higher rate than those without fully funded graduate education. The utilization results are interesting. Officers who use their p-code early are screened at a lower rate than the officers who do not pursue fully funded education.[15]

[15] There were only 8 officers that utilized early, and only 3 of those were XO screened. So the total percentage of officers who use early was 27 percent of the entire sample. This is not a large enough group in this researchers eyes to make statistical inferences about the effect of early utilization on the outcome of XO screening.

Table 4.4 Percentages of those who Screen for XO, or CO or Promote to O-6 by Type of Graduate Education and by Utilization

	XOSCRN	COSCRN	PROMOTE to O-6
Grad Ed:			
Fully Funded	69.5%	51.1%	46.0%
Not Fully Funded	47.7%	37.5%	32.0%
Fully Funded:			
Technical	62.5%	48.5%	43.6%
Non-Technical	79.8%	54.0%	48.6%
Utilization:			
Use Early	37.5%	39.4%	27.2%
Use Later	NA #	NA #	52.5%
Sample Size	2,925	1,471	1,471

Note: "Not Fully Funded" includes part time graduate education, and no graduate education categories,
"Later" utilization happens after the screening process and may not be considered a causal factor.

The results at the CO screening and promotion to O-6 are similar. Officers who have fully funded degrees screen and promote at higher rates than the officers with no fully funded education. The non-technically educated officers, in the fully funded subset, screen and promote at a higher rate than officers with technical degrees. But, those with technical funded degrees are more likely to screen and promote than officers without fully funded education. The utilization results show that officers with early utilization entering the CO screening process have only a slightly better chance of success than those who have no fully funded education (39.4 percent compared with 37.5 percent). However, later utilization improves promotion chances; the promotion rate to O-6 is 52.5 percent for those who

utilize late compared to only 32 percent for those who do not possess a fully funded degree.

B. OFFICER PERFORMANCE AND SELECTION BIAS

It is important to remember that officers who choose graduate education are officers with stronger academic backgrounds and stronger early performance when rated by their superiors. "Selection bias" will occur if the officers who select graduate education are also officers who would screen and promote even in the absence of attendance at graduate school. If some reasons causing officers to choose fully funded graduate education and are not observed in the data (i.e., non-observed factors) and are correlated with the outcome of screening, selection bias will exist. Some of these non-observed factors may include motivation, perseverance, eagerness, and in general a stronger desire to succeed. Testing for the presence of selection bias will therefore be necessary if we are to derive unbiased estimates of the impact of graduate education on career progression.

The test for selection bias involves determining if graduate education is related to officer performance indicators prior to the period of graduate education. Since graduate education can not affect prior service performance, this test will indicate selection bias if graduate education and prior performance are significantly related. If the relationship is not statistically significant, it may be assumed that any unobserved differences in prior performance are captured by observed characteristics already

included in the model. A single measure of early performance, RAPPED, is used as the dependent variable in the selection bias test, since this is the only available measure of junior officer performance. Table 4.5 shows the frequencies of RAPPED officers for each of the three data sets. It is apparent that the percentage of RAPPED reports decrease in the more senior data sets. This might be attributed to a different philosophy in the grading of junior officers before fitness report inflation became an issue. It also might be a signal that other factors are more important for screening and promotion at the higher grades, or there may be errors in measurement for this variable in the older data set.[16]

Table 4.5 Frequencies of RAPPED variable by Data Set

Data Set	Sample Size	RAPPED	Percent with RAPPED
LT-LCDR	8,269	3674	44.43%
LCDR-CDR	2,925	1,187	40.58%
CDR-CAPT	1,471	221	15.02%

Once the selection bias test is chosen, a probit model with the RAPPED variable as the dependent variable is estimated.[17] The important variables from the graduate education models, APC1 and UGTECH, are added as well as the variables from the XO screening, CO screening and CAPT promote models. Table 7 shows the parameter estimates for the

[16] If the latter is true, the graduate education estimates in the selection bias tests will be biased.
[17] Heckman and Robb, "Alternative Methods for Evaluating Impact of Interventions: An Overview", Journal of Econometrics, 1985, (30), pp 239-267.

selection bias tests for the measures of performance used in this analysis. The complete list of parameter estimates for the selection bias tests are included in Appendix C1 and Appendix C2.

The results of the selection bias test indicate that there is bias in the XOSCRN performance measure model, but not in the COSCRN and PROMOTE models. This may be explained because the selection process at the LCDR promotion board is so thorough that the officers who pass through are fairly homogenous in their non-observable traits. This means, for example, that those with graduate education and those without graduate education have similar motivation, perseverance and zeal. Possibly, a second reason exists, which is that the younger data set is composed of a more heterogeneous group. The distribution of non-observable variables may be systematically related to graduate education, which would cause selection bias in the LCDR -CDR data set. An upward bias to graduate education measures used in later analysis is identified by these tests. One must note when the bias is found, and the direction of potential bias.

Table 4.6 Estimated Probit Coefficients of Graduate Education Variables in Models of Junior Officer Performance (RAPPED) Prior to Graduate Schooling (Selection Bias Test)

Probit Coefficients by Graduate Education Measures by Data Set and by Model Specification		
	LCDR-CDR Data Set	**CDR-CAPT Data Set**
Model One:		
Fully Funded Grad Ed	.4683*** (.0556)	**.1232** (.0876)
Model Two: Fully Funded		
Technical	.4079*** (.0685)	**.1365** (.1104)
Non-Technical	.5538*** (.0793)	**.1088** (.1136)
Model Three: Utilization		
Use Early	NA	.7415*** (.2441)
Use Later	NA	**.1110** (.1408)
Sample Size	2,925	1,471
Note: * Significant at .10 Level ** Significant at .05 Level *** Significant at .01 Level		

Note: **Bold** numbers indicate no selection bias. Model One from column 1, Appendix C1 and Appendix C2; Model Two from column 2, Appendix C1 and Appendix C2; Model Three from column 3, Appendix C1 and Appendix C2.

When selection bias is detected a two stage least squares model should be run in order to try to control the selection bias. The two stage least squares approach would have been appropriate, but the two stage least square model is a linear model and the career progression outcomes are binary and therefore require a non-linear model. The statistical computer package available for this research (SAS), was not capable of producing an accurate two-step bivariate probit or instrumental variable model. However,

a two stage linear model for the XO screen career progression outcome is added in Appendix D to indicate to the reader that the signs of the estimators and their statistical significance are often comparable with the single stage non-linear probit models.

The non-linear probit model therefore provides an indication of the sign and reliability of the estimate. As long as selection bias is known to exist it can be accounted for by noting its direction in later modeling efforts.

C. ESTIMATED IMPACT OF GRADUATE EDUCATION

This section provides the probit results for the various measures of graduate education, which include fully funded graduate education (FFGE), fully funded technical graduate education (FFTCGRAD), fully funded non-technical graduate education (FFNTGRAD) and utilization (Use Early and Use Later).

1. Fully Funded Graduate Education

The explanatory variables specified are chosen from those suggested by human capital theory, as well as those used to control for personal background characteristics. Models were run with a variety of variables. As mentioned in the previous chapter, fiscal year dummies were included but found to have no significant effect and were then deleted. This can also be said for the APC, UGTECH and the early preference variables. They were

significant for the graduate education models but when used in the screening and promotion outcome models became insignificant. [18]

a. Graduate Education Variable

Table 4.7 shows the results of the three career progression models that focus on the effect of fully funded graduate education status.

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[18] Consecutive models were constructed to determine the effect of adding more control variables on the fully funded graduate education variable. The fully funded graduate education coefficient changed from a statistically significant .283 in the first model to a statistically significant .249 in the last model. With the observed characteristics added to the model, the fully funded coefficients dropped by only .034 in magnitude.

Examining the models, it is apparent that fully funded graduate education has a large positive and significant impact. As was believed, fully funded education is a help to an officer's career. It is also observed that superior early performance, as measured with the RAPPED variable, has a large positive and significant effect. As noted in previous studies, married individuals with or without children have been found to experience more successful careers. These models for CO screening support this conclusion. The models are believed to represent the most complete specification given the available data set.

Table 4.7 Officer Performance Models of Graduate Education Status: Non-Linear Probit Models.

	XOSCRN	COSCRN	PROMOTE to O-6
INTERCEPT	1.6699*** (.3600)	2.5395*** (.6594)	2.8559*** (.6902)
Fully Funded Grad Ed	.3624*** (.0589)	**.2499*** (.0732)**	**.2772*** (.0739)**
Age at Commissioning	-.0915*** (.0163)	-.1363*** (.0297)	-.1606*** (.0311)
Married Only	.2345*** (.0738)	.2440* (.1498)	.2803* (.1546)
Married with Children	.1941*** (.0662)	.3508*** (.1250)	.3985*** (.1296)
Divorced with Children	.0411 (.1550)	-.2867 (.2413)	-.2565 (.2540)
ROTC	-.1013 (.0645)	-.1955** (.0872)	-.1899** (.0884)
OCS	.0835 (.0781)	-.1089 (.0919)	-.0421 (.0933)
NESEP	-.3204*** (.1152)	-.1308 (.1788)	-.0106 (.1852)
Received RAP as O-1 - O-2	.8173*** (.0511)	.3144*** (.0938)	.2978*** (.0942)
Male	.6914*** (.2255)		
African American	-.0040 (.1102)		
Other Minority	-.0120 (.2037)		
Concordance Ratio	.731	.635	.640
-2 Log L	518.8	104.9	107.9
Sample Size	2,925	1,471	1,471

Note: * Significant at .10 Level
** Significant at .05 Level
*** Significant at .01 Level

Note: **Bold** numbers indicate no selection bias.

The results in the promotion model to CAPT are similar to the results in the CO screening model. Fully funded graduate education is positive and significant, and no selection bias is suspected. The graduate education effect appears to be greater in the O-6 promotion model. As explained earlier, in these CDR -CAPT models selection bias tests showed no bias for the graduate education variable. Therefore, the effect of graduate education is positive and significant on CO screening and promotion to the CAPT level as reported in Table 4.7.

Examining the XO screening probit model, in Table 4.7, the fully funded graduate education coefficient is positive and significant. However, it also is positive and significant in the RAPPED model used to test for selection bias (see Table 4.6, above). As noted earlier, selection bias may be due to the non-observable factors being systematically related to the choice of fully funded graduate education and later officer performance. The effect of the positive selection bias would reduce the probit parameter estimate of the effect of graduate education. Again, the bivariate probit or instrumental variable technique would be a better model to use to correct for the selection bias.

b. Other Explanatory Variables

In the CO screening and O-6 promotion models, the age variable is significant and indicates that the older the officer is when they are commissioned reduces their chances of screening and promoting. Officers

who are married have a better chance of screening and promoting than officers who are divorced or single. The other variables in the XO screening probit model are similar to the CO screening models. Married officers with and without children have a greater chance of screening, older officers compared to their contemporaries have less of a chance of screening. It is interesting that if you are a female officer there is a large positive and significant effect on the chance of screening for XO, while the race variables are insignificant. Officers who were prior enlisted and entered through the NESEP program had a lower chance for screening to XO.

2. Technical versus Non-Technical

a. Graduate Education Variables

The models when fully funded graduate education is broken into technical (FFTCGRAD) and non-technical (FFNTGRAD) graduate degrees are shown in Table 4.8

TABLE 4.8 Probit Parameter Estimates for XO Screening, CO Screening, and Promotion to Captain Models with Technical and Non-Technical Degrees as Graduate Education Measures

	XOSCRN	COSCRN	PROMOTE to O-6
INTERCEPT	-.3076*** (.0708)	2.5519*** (.6599)	2.8668*** (.6906)
Fully Funded Technical Grad Ed	.2145 (.0704)	**.1886**** (.0936)	**.2237**** (.0944)
Fully Funded Non-Technical Grad Ed	.6572 (.0907)	**.3147***** (.0955)	**.3335***** (.0959)
Age at Commissioning	-.0922 (.0188)	-.1365*** (.0297)	-.1608*** (.0312)
Married Only	.2293*** (.0738)	.2395 (.1499)	.2756* (.1546)
Married with Children	.1624** (.0658)	.3466*** (.1250)	.3941*** (.1296)
Divorced with Children	.0306 (.1551)	-.2851 (.2413)	-.2553 (.2539)
ROTC	-.1093* (.0646)	-.2044** (.0876)	-.1976** (.0888)
OCS	-.1817*** (.0657)	-.1151 (.0921)	-.0474 (.0935)
NESEP	-.7325*** (.0873)	-.1222 (.1790)	-.0026 (.1854)
Received RAP as O-1 - O-2	.8155*** (.0511)	.3167*** (.0939)	.2995*** (.0942)
Male	.7089*** (.2252)		
African American	.0127 (.1099)		
Other Minority	-.0269 (.2021)		
Concordance Ratio	.723	.638	.643
-2 Log L	505.1	106.0	108.8
Sample Size	2,925	1,471	1,471

Note: * Significant at .10 Level
** Significant at .05 Level
*** Significant at .01 Level

Note: **Bold** numbers indicate no selection bias.

As shown in the table, either type of graduate education has a positive significant effect on career progression from CO screening to O-6 promotion compared to officers with no fully funded graduate education (which includes those officers with no graduate education and officers with only part time graduate education). The test for selection bias found that there was no selection bias in the fully funded technical versus fully funded non-technical models, thus those estimates in Table 4.8 are not biased.

The pursuit of a technical degree does not help an officer's chance of screening or promotion as much as a choice of a non-technical degree. In both models in the CDR-CAPT data set, the size of the parameter estimate of non-technical graduate education is more than a third larger than the technical estimate.

The results of the XO screening model indicate that neither type of graduate education is significant. Furthermore, the earlier selection bias tests indicated that a positive bias is suspected in this model. While the coefficients of the partitioned technical and non-technical graduate education variables are positive, their unbiased impact and significance can not be determined because of the potential selection bias. [19]

[19] Using our experience from the CDR-CAPT data set and examining the technical and non-technical variables more closely, it may be safe to assume that officers with non-technical graduate education have a better chance of XO screening than those who have technical graduate education. However, drawing any conclusions is risky due to the lack of statistical significance in the technical and non-technical variables.

b. Other Explanatory Variables

As found in the original screening and promotion models in Table 4.8, the officer's early performance (RAPPED) is positive and highly significant. The marital status variables are positive, but officers without children are less positive and not as significant as those officers married with children. The accession sources, other than ROTC, are insignificant. ROTC graduates appear to have a lower chance of screening or promoting to CAPT than U. S. Naval Academy Graduates. It is somewhat surprising that ROTC graduates are less likely to promote and screen. The officers from OCS and the NESEP program appear to progress no differently than Academy graduates since the parameter estimates are not significant and can be assumed to be zero.

3. Utilization

The last section considers the effect of sub-specialty utilization of those with fully funded graduate degrees on career success. The early utilization variable (Use Early), can only be used in the senior models due to the small numbers of officers who have used their sub-specialty early in other data sets.

In the LCDR-CDR data set, only 8 officers (.27 percent), utilized their sub-specialty early. Furthermore, the comparison of early with later utilization (Use Later), can only be done in the O-6 promotion model. In that model, both early and late utilization occurs before the O-6 promotion

measure of career progression. It may also be noted that the utilization coefficients are interactive coefficients with the fully funded graduate education variables, since one can not utilize sub-specialty knowledge without first having attended graduate school. This allows for a comparison not only between officers who utilize early (Use Early) and officers who utilize late (Use Later), but also between officers who have graduate education and do not utilize at all (FFGE). The coefficients for fully funded graduate education must be added to the utilization variables in order to determine the full effect of the utilization outcome measures.

The results of the probit models are shown below in Table 4.9.

Table 4.9 Probit Parameter Estimates for CO Screening, and Promotion to Captain Models with Early Utilization and Late Utilization as Graduate Education Measures

	COSCRN	PROMOTE to O-6
INTERCEPT	2.4232*** (.6621)	2.7363*** (.6937)
Fully Funded Grad Ed	.0832 (.0929)	**.1342** (.0940)
Use Early	-.6274** (.2454)	-.8408*** (.2576)
Use Later		**.3953***** (.1205)
Age at Commissioning	-.1317*** (.0298)	-.1560*** (.0313)
Married Only	.2522* (.1507)	.2877* (.1556)
Married with Children	.3638*** (.1258)	.4152*** (1306)
Divorced with Children	-.2824 (.2428)	-.2505 (.2560)
ROTC	-.2036** (.0875)	-.1982** (.0888)
OCS	-.1139 (.0922)	-.0460 (.0936)
NESEP	-.1255 (.1794)	-.0064 (.1861)
Received RAP as O-1 - O-2	.3284*** (.0947)	.3237*** (.0952)
Concordance Ratio	.647	.656
-2 Log L	120.3	125.5
Sample Size	1,471	1,471
Note: * Significant at .10 Level ** Significant at .05 Level *** Significant at .01 Level		

Note: **Bold** numbers indicate no selection bias.

As shown in the table, both the early utilization parameter estimates are negative and significant, while the later utilization parameter estimate in the O-6 promotion model is positive and significant. Selection bias exists

in the early use coefficient, meaning that the impact of early utilization may be biased upward. This suggest that the negative coefficient observed, if corrected for the selection bias, would be more negative. Again, utilizing graduate education implies that the officer had to acquire graduate education, so the fully funded graduate education variable parameter estimate must be added to the utilization parameter estimates to determine the full effect of utilization. In these models, the fully funded graduate education variable measures the impact of getting a p-code but never utilizing the skill in a sub-specialty billet compared to those without a p-code. Here we find that the parameter estimate on FFGE is still positive, but is not significant. There is no selection bias in either the FFGE or Later USE measures of graduate education, as indicated in the selection bias tests above.

It is important to remember that the Use Early variable indicates the use of graduate education before the lower board of the data set, that is, as a LCDR appearing before the CDR promotion board. As noted earlier the selection bias test indicates an upward bias in the Use Early variable. That is, the actual parameter estimate could possibly be more negative than the model predicts. Therefore, we conclude that utilization early in a career, anytime as a LCDR or before, may decrease an officer's chance of screening or promoting later. Conversely, ultimate utilization as a CDR shows a positive effect on CAPT promotion. As such, the best chance of promotion

occurs when the following career progression occurs: an officer accomplishes graduate education, promotes to CDR, screens for CO and then utilizes his/her graduate education. It indicates that officers who utilize their p-code after CO screening have a better chance of promoting to O-6. The other estimates for early performance, age at commissioning, married and accession source are consistent with the original and technical versus non-technical models discussed above.

D. SUMMARY

The analysis of SWO career progression reported in this study indicates that officers who pursue graduate education are better early performers, and have stronger academic backgrounds. Officers who have a non-technical graduate education are slightly more likely to CO screen and promote to O-6 than officers with a technical graduate education. Finally, the officers who utilize their graduate education in a p-coded billet as a LCDR have a lower chance of screening and promoting compared to those who never used their sub-specialty or who were not p-coded. There is also a selection bias present which means that the parameter estimate for early utilization may be even more negative then suggested in this study. Officers who wait until they are CDRs to utilize their sub-specialty have a greater chance of promoting to CAPT than those who never used their sub-specialty or who were not p-coded.

Summarizing the findings in the LCDR-CDR data set is more tenuous, since there was definite evidence of selection bias for this younger data set. Taking that into account, the exact relationship between possession of a graduate degree and the study outcomes can not be estimated with sufficient statistical certainty. Fully funded graduate education provides a positive effect on the XO screening model, but how positive is hard to determine. The only conclusive result of the effects of technical and non-technical graduate education that may probably be drawn from this LCDR-CDR data, is that officers with non-technical graduate education are more likely to XO screen than those with technical graduate education. The effect of utilization could not be analyzed for the XO screening process since there were only 8 officers who had used their subspecialty before the screening board.

The final chapter will reexamine some of these results, and offer some conclusions on graduate education and why the CDR-CAPT data set was not as affected by selection bias as the LCDR-CDR data set. It will also offer some recommendations for further study.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This analysis was conducted to determine the effect of graduate education on the careers of Surface Warfare Officers. Other issues explored in this thesis include the effect of a technical versus a non-technical degree on job performance, and the effect of utilization in a p-coded billet on promotion and screening opportunities. The conclusion reached is that graduate education has a positive influence on an officer's career. From data on early performance it was found that officers who pursue graduate degrees have stronger undergraduate backgrounds and stronger job performance early in their careers. Also they are more likely to stay in the military.

The observation of early performance indicators linked to graduate school selection and career performance led to the exploration of the selection bias issue in data on later job performance. It appears that the performance of the middle group of officers (LCDRs coming up to the O-5 promotion board) was affected by selection bias, while the performance of the senior group (CDRs coming up to the O-6 promotion board) was not. One explanation for a selection bias early in an officer's career is that the screening that takes place at the middle level, the LCDR promotion and XO screening boards, is so restrictive that the officers survive these "up-or-out" screens are relatively homogenous in terms of ability and performance. The screening process may be so restrictive that officers who survive to the later CO

screening and CAPT promotion board are all highly effective Naval officers. This seems to be the most credible explanation for the lack of selection bias in the more senior data set. The officers who are advanced to O-5 have been selected for their advancement because they are the most able and effective officers among their peers. A less likely explanation in this researcher's eyes is that the senior (O-6) data set contains a different type of person then the younger (O-5) data set. This explanation, however, seems implausible since some of the officers could be in both data sets. Thus, we conclude that it is the rigorous selection process that produces a homogenous group of highly qualified and productive officers after the O-5 point.

Conclusions may also be drawn regarding the utilization of officers in p-coded billets. The officers who waited the longest to utilize their graduate education had the best chance to be promoted and screened. How much the early utilization hurt the officer or how much the later utilization helped an officer is difficult to gauge. The only determination is that officers who utilized their graduate education as an O-5 had a better chance to promote to CAPT.

The study of Navy-funded technical degrees compared to non-technical degrees revealed that officers with non-technical majors had a higher probability of promoting. These results may suggest that non-technical fields of study are more relevant at the senior management levels in the Navy. Officers with technical skills are important for the development

of new weapons system, but the officers that have stronger people, management, budgeting and decision making skills are the ones that have the better promotion chances.

B. RECOMMENDATIONS

The results of this analysis may lead the Navy to consider some small modifications to the graduate education system that is currently in place. Since we know that officers who desire graduate education are more likely to stay in the Navy and have a higher probability of promoting and screening, the identification of these officers early in their careers may offer an advantage to the military. The earlier these traits are known the more effective the Navy can be in its use of this officer. The cost savings to the Navy by sending the officer to graduate school earlier in their career would be the main benefit. It is much cheaper to pay an Ensign or Lieutenant Junior Grade salary for 18 to 24 months than it is to pay a senior Lieutenant or Lieutenant Commander. The timing of graduate education may need to be studied in more detail.

Another recommendation stemming from this research concerns the timing of utilization tours. The analysis shows that the later the utilization occurs in the officer's career the better for the individual officer. The Navy may have to rethink its position on this. The longer the time lapse between acquisition of the degree, the lower the retention of the knowledge. Officers who utilize their graduate training as CDRs may not remember all that they

were taught, or in some cases the knowledge they acquired may have changed and become outdated. The Navy may want to change the utilization requirement, or the perception at screening and promotion boards that a utilization tour is a detriment to an officer's career. It is hard to fault the promotion and screening boards when they must choose between two officers, one of which has been competitive with his peers out at sea and the other, who is ranked one of one and has been behind a desk on a utilization tour. The solution may be for the Navy to place the utilization tour immediately following graduate education, making it a full three year tour, and giving the officer a competitive evaluation. An alternative option would be to delay everyone's utilization tours until they reach the O-5 grade. This would seem to be the least palatable option to ensure a return on investment for the Navy, since as stated above, the longer the time between acquiring the degree and its use the more that is likely to be forgotten. However, it is possible that this could be offset by providing refresher training prior to assignment to a utilization tour.

The last recommendation deals with the number of officers with technical and non-technical degrees. The Navy may want to study a policy of reducing the percentage of officers with technical degrees and increasing the number with non-technical degrees. The results show that the attributes of the non-technically educated officers may be more desirable at promotion and screening boards. As mentioned before, the knowledge and skills most

beneficial for a senior officer may stem more from non-technical than from technical education.

C. FURTHER RESEARCH

This study has a few flaws that should be corrected. The statistical analysis program used(SAS) was not capable of estimating a bivariate probit procedure or an instrumental variables procedure for probit models. The estimates attained in this study are as accurate as possible but can provide only an indication as to the direction of the effect and significance of the explanatory variables.

Another modification that should be made, if the data can be obtained, is to develop other reliable measures of performance. The RAPPED variable used in this study contained information from the early fitness reports. If some other performance measures could be devised that indicated motivation, eagerness, or taste for military service, or any number of other unobserved factors, it would provide a more reliable analysis of the determinants and effects of graduate education. As of this study none of those factors were available in the data set.

APPENDIX A: DESCRIPTION OF THE SUBSPECIALTY CODES

The subspecialty code is made up of five characters consisting of four numerals and one alphabetic character. The first two digits in a subspecialty code denote a unique field referred to as a functional field. This field changes from 00 to a more descriptive code (for example 10, 20 ,30 and so on) denoting the particular area in which an officer received his or her p-code.

The second two digits of the subspecialty code describe the education field in which the officer obtained a subspecialty, and is usually referred to as an educational/training/ experience field. These two digits were used to determine technical vice non-technical fields of study. Those p-codes less than XX40 were deemed non-technical. These non-technical subspecialtities deal with the managerial sciences and national security affairs curricula mostly.

The suffix attached to the subspecialty code states the level of education or experience pertaining to the subspecialty and is referred to as a subspecialty code suffix. Suffixes assigned for graduate education are P and Q. P means an officer has been assigned a subspecialty based on the completion of graduate education. A Q suffix means the officer is a proven subspecialist, having served successfully in one or more billets pertaining to his or her subspecialty or an approved, related subspecialty after completion of graduate education.

The proven subspecialist codes apply only to URL officers and to the Nurse and Medical Service Corps. Further, these codes only apply to the ranks of LCDR through CAPT. A P-Code requires the combination of both professional experience and extensive knowledge of theories, principles , processes and/or techniques certified through the acquisition of the master's degree for optimum performance of duty.

A Q-Code requires either the conception , implementation, appraisal, or management of complex Navy and/ or DoD programs. Also, one of the following criteria must be met: the officer must routinely interact with personnel who possess a master's degree; or the officer must exercise technical, educational, or managerial supervision over personnel who possess a master's degree. Further, the billet requires a proven subspecialist at the master's degree level. This naval officer is usually "board selected" as a proven subspecialist after successful completion of one or more significant tours in a master's degree level billet in the subspecialty field.

APPENDIX B: VARIABLE DEFINITIONS

VARIABLE NAME	DESCRIPTION
XOSCRN	1= Promoted to LCDR and Screened for Executive Officer 0= Promoted or not Promoted to LCDR but not Executive Officer Screened
COSCRN	1= Promoted to CDR and Screened for Commanding Officer 0= Promoted or not Promoted to CDR but not Commanding Officer Screened
PROMOTE	1= Promoted to CAPT 0= Not Promoted to CAPT
GEDUC	1= Any Graduate Education 0= No Graduate Education
FFGE	1= Fully Funded Graduate Education 0= No Fully Funded Graduate Education
FFTCGRAD	1= Fully Funded Technical Graduate Education 0= Not Fully Funded Technical Graduate Education
FFNTGRAD	1= Fully Funded Non-Technical Graduate Education 0= Not Fully Funded Non-Technical Graduate Education
AFAMER	1= African American 0= Not African American
OTHRACE	1= Other Minority 0= Not Other Minority
GENDER	1= Female 0= Male
MARONLY	1= Married with no children 0= Not Married with no children
MARCHILD	1= Married with more than one child 0= Not Married with more than one child
DIVCHILD	1= Divorced with more than one child 0= Not Divorced with more than one child
ROTC	1= ROTC Graduate 0= Not ROTC Graduate
OCS	1= OCS Accession 0= Not OCS Accession
NESEP	1= NESEP Accession 0= Not NESEP Accession
APC1 (Academic Profile Code)	5= College GPA of 0-1.89 4= College GPA of 1.90-2.19 3= College GPA of 2.20-2.59 2= College GPA of 2.60-3.19 1= College GPA of 3.20-3.59 0= College GPA of 3.60-4.00
UGTECH	1= Undergraduate Degree in Science or Technical Field(Math, EE, ME, Biology, Geology, Chemistry, etc...) 0= Undergraduate Degree Other Than Science or Technical Field
AGE01	Years of Age at Commissioning
RAPPED	1= Received a Recommended for Early Promotion as an ENS or LTJG 0= No Recommended for Early Promotion Fitreps as an ENS or LTJG
LCBD82-LCBD89	1= Promoted to LCDR in that Fiscal Year 0= Not Promoted to LCDR in the Fiscal Year

EVERUSE	1= Utilized Graduate Education at the Lower Promotion Board of Data Set 0= Did Not Utilize Graduate Education by the Lower Promotion Board of Data Set
HEVERUSE	1= Utilized Graduate Education by Upper Promotion Board of Data Set 0= Did Not Utilize Graduate Education by Upper Promotion Board of Data Set
TCPREF	1= Technical Preference 0= No Technical Preference
NTPREF	1= Non-Technical Preference 0= No Non-Technical Preference
BOTHPREF	1= Technical and Non-Technical Preference 0= No Technical and Non-Technical Preference

APPENDIX C.1

Estimated Probit Coefficients of Graduate Education Variables in Models of Junior Officer Performance Prior to Graduate Schooling: Selection Bias Test

LCDR-CDR Data Set

(Dependent variable = RAPPED)

	Model One	Model Two	Model Three
INTERCEPT	.4751 (.3550)	.4863 (.3553)	.4819 (.3551)
Fully Funded Grad Ed	.4683*** (.0556)		.4395*** (.0611)
Male	.2690 (.1965)	.2614 (.1969)	.2666 (.1966)
African American	-.3480*** (.1144)	-.3450*** (.1143)	-.3460*** (.1143)
Other Minority	-.5806*** (.2216)	-.5736*** (.2214)	-.5832*** (.2218)
Age at Commissioning	-.0272* (.0158)	-.0277* (.0158)	-.0277* (.0158)
Married Only	.0854 (.0719)	.0840 (.0719)	.0866 (.0719)
Married with Children	.0572 (.0647)	.0588 (.0647)	.0607 (.0647)
Divorced with Children	.0703 (.1510)	.0715 (.1510)	.0635 (.1514)
ROTC	-.0607 (.0628)	-.0625 (.0629)	-.0612 (.0629)
OCS	.0257 (.0760)	.0199 (.0761)	.0266 (.0760)
NESEP	-.0620 (.1155)	-.0626 (.1155)	-.0639 (.1155)
APC1 (Grades)	-.0631** (.0266)	-.0654** (.0266)	-.0621** (.0266)
Under Graduate Technical Major	-.1319** (.0520)	-.1188** (.0527)	-.1377*** (.0521)
Fully Funded Technical Grad		.4079*** (.0685)	
Fully Funded Non-Technical		.5538*** (.0793)	
Use Early			.6575 (.5006)
Use Later			.0946 (.0974)
Concordance Ratio	.625	.626	.625
-2 Log L	138.8	141.1	142.1
Sample Size	2,925	2,925	2,925

Note: * Significant at .10 Level
** Significant at .05 Level
*** Significant at .01 Level

APPENDIX C.2

Estimated Probit Coefficients of Graduate Education Variables in Models of Junior Officer Performance Prior to Graduate Schooling:
Selection Bias Test
CDR-CAPT Data Set
(Dependent Variable = RAPPED)

	Model One	Model Two	Model Three
INTERCEPT	-.1966 (.7722)	-.2002 (.7722)	-.1824 (.7777)
Fully Funded Grad Ed	.1232 (.0876)		-.0018 (.1128)
Married Only	-.0183 (.0349)	-.0184 (.0349)	-.0195 (.0351)
Married with Children	-.1705 (.1697)	-.1702 (.1698)	-.1538 (.1701)
Divorced with Children	-.1757 (1381)	-.1752 (.1381)	-.1735 (.1384)
ROTC	-.5363* (.2962)	-.5374* (.2963)	-.5550* (.3004)
OCS	-.1487 (.1059)	-.1469 (.1064)	-.1468 (.1063)
NESEP	-.1082 (.1111)	-.1069 (.1114)	-.1128 (.1115)
RAPPED	-.3017 (.2242)	-.3014 (.2242)	-.2997 (.2252)
APC1 (Grades)	-.1074** (.0457)	-.1070** (.0457)	-.1060** (.0460)
Under Graduate Technical Major	.1808** (.0898)	.1783** (.0907)	.1863** (.0902)
Fully Funded Technical Grad Ed		.1365 (.1104)	
Fully Funded Non-Technical Grad Ed		.1088 (.1136)	
Use Early			.7415*** (.2441)
Use Later			.1110 (.1408)
Concordance Ratio	.599	.600	.609
-2 Log L	24.2	24.3	36.5
Sample Size	1,471	1,471	1,471

Note: * Significant at .10 Level
** Significant at .05 Level
*** Significant at .01 Level

APPENDIX D: COMPARISON OF PROBIT XO SCREENING MODELS WITH OLS AND 2SLS MODELS

Probit Parameter Estimates for XO Screening, and RAPPED Models for the LCDR-CDR Data Set and OLS and 2SLS Models of XO Screening.

	XOSCRN	RAPPED	OLS XOSCRN	2SLS XOSCRN
INTERCEPT	1.6699*** (.3600)	.4751 (.3550)	1.0637*** (.1233)	1.0779*** (.1351)
Fully Funded Grad Ed	.3624*** (.0589)	.4683*** (.0556)	.1270*** (.0200)	.1024 (.0977)
Male	.6914*** (.2255)	.2690 (.1965)	.2216*** (.0703)	.2256*** (.0727)
African American	-.0040 (.1102)	-.3480*** (.1144)	-.0029 (.0384)	-.0062 (.0404)
Other Minority	-.0120 (.2037)	-.5806*** (.2216)	-.0078 (.0703)	-.0090 (.0705)
Age at Commissioning	-.0915*** (.0163)	-.0272* (.0158)	-.0313*** (.0055)	-.0316*** (.0057)
Married Only	.2345*** (.0738)	.0854 (.0719)	.0837*** (.0256)	.0848*** (.0260)
Married with Children	.1941*** (.0662)	.0572 (.0647)	.0696*** (.0229)	.0719*** (.0247)
Divorced with Children	.0411 (.1550)	.0703 (.1510)	.0204 (.0533)	.0207 (.0533)
ROTC	-.1013 (.0645)	-.0607 (.0628)	-.0374* (.0223)	-.0408 (.0259)
OCS	.0835 (.0781)	.0257 (.0760)	.0248 (.0269)	.0215 (.0298)
NESEP	-.3204*** (.1152)	-.0620 (.1155)	-.1113*** (.0393)	-.1146*** (.0414)
Received RAP as O-1 - O-2	.8173*** (.0511)		.2972*** (.0175)	.3007*** (.0221)
APC1 (Grades)		-.0631** (.0266)		
Under Graduate Technical Major		-.1319** (.0520)		
Concordance Ratio	.731	.625	R-Square = .165	R -Square = .156
-2 Log L	518.8	138.8		
Sample Size	2,925	2,925	2,925	2,925

Note: * Significant at .10 Level
**Significant at .05 Level
***Significant at .10 Level

It would be inappropriate to compare the estimates from the single stage model directly to the two stage model so the single stage ordinary least squares model is included for comparison purposes. The fully funded graduate education parameter estimates show that when the correction procedure is completed the coefficient's value decreases and the standard error nearly quadruples. The standard errors are derived from the fitted data but need to be calculated with the actual data. The computer program available was deficient in this regard.

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